

Claims

1. A WDM module comprising a plurality of WDM laser assemblies, each laser assembly comprising a laser source, wherein the WDM is arranged, in use, in a manner such that a controlled temperature environment is created around the laser sources of the laser assemblies, the controlled temperature environment being defined by a high and a low reference temperature value and having a temperature range equal to or smaller than an inherent operation temperature range of the laser sources, and in a manner such as to be capable of creating the controlled temperature environment around the laser sources while the WDM module is subjected to an outside temperature ambient having a temperature range larger than the inherent operation temperature range of the laser sources.

2. A module as claimed in claim 1, wherein the high reference temperature is 70°C or less.

3. A module as claimed in claims 1 or 2, wherein the low reference temperature is at least 0°C.

15 4. A module as claimed in any one of claims 1 to 3 comprising:

- a housing,

- a chassis member located substantially inside the housing and adapted to function as a heat sink,

20 - a heat sink structure extending from the housing and in thermal communication with the chassis member,

- a thermoelectric (TE) device in thermal communication with the chassis member,

- at least one heat generating electrical component in thermal communication with the chassis member, and

25 - a control unit arranged, in use, to maintain a controlled temperature environment inside the housing utilising the heat sink structure, the TE device, and the heat generating electrical component and utilising the chassis member as a thermal communication medium.

5. A module as claimed in claim 4, wherein the module further comprises one or more highly thermally conductive members formed in or on the chassis member to facilitate the heatsink functionality of the chassis member.

6. A module as claimed in claims 4 or 5, wherein the module further comprises a local thermal environment structure located inside the housing and the TE device is in thermal communication with the chassis member and the local thermal environment structure,

5 whereby, in use, a second stage controlled temperature environment is created substantially inside the local thermal environment structure, and

wherein temperature variations in the second stage controlled temperature environment are smaller than temperature variations inside the housing.

7. A module as claimed in claim 6, wherein the module comprises at least one laser source disposed in a manner such that, in use, the source temperature of the laser source is 10 substantially governed by the second stage controlled temperature environment.

8. A module as claimed in claim 7, wherein the laser source is a semiconductor laser source, and a junction of the laser source is located substantially inside the local thermal environment structure.

9. A module as claimed in claim 8, wherein a laser driver associated with the laser source is located substantially outside the local thermal environment structure, whereby the thermal environment around the laser driver is governed by the controlled temperature environment inside the housing.

10. A module as claimed in any one of claims 4 to 9, wherein the module comprises a plurality of electrical components, and the control unit is further arranged, in use during start-up or re-start of the module, to sequentially switch on the electrical components based on operating temperature specifications and heat generating characteristics of the electrical components to facilitate creation of the controlled temperature environment.

11. A module as claimed in any one of claims 4 to 10, wherein the heat sink structure comprises at least one heat pipe.

25 12. A module as claimed in claim 11, wherein the heat pipe has a working fluid characterised by a freezing temperature above -40°C, whereby a discontinuity in heat transfer to and from the heat sink structure is created for temperatures below the freezing temperature of the working fluid in the heat pipe for reducing heat loss from the inside of the housing.

13. A module as claimed in claim 12, wherein the freezing temperature is about zero °C.

14. A module as claimed in any one of claims 4 to 13, wherein the chassis member comprises side walls formed around the peripheral region of a main body of the chassis member, and said side walls form at least a portion of housing side walls of the housing.

15. A module as claimed in any one of claims 4 to 14, wherein the housing is adapted to function as an electro-magnetic induction (EMI) shield.

16. A module as claimed in any one of claims 4 to 15, wherein the module further comprises biasing means for biasing the chassis member with respect to the heatsink structure.

10 17. A module as claimed in any one of claims 4 to 16, wherein the module further comprises a first key member arranged, in use, to cooperate with a second key member formed on a casing member into which the module is inserted, to prevent the module from making contact with a backplane of the casing member when the module is inserted upside down into a slot of the casing member for which the module is not intended.

15 18. An optical network node incorporating a WDM module as claimed in any one of the preceding claims.

19. An optical network node as claimed in claim 18, wherein the network node is in the form of a regenerator node for a WDM network.

20 20. An optical network node as claimed in claim 19, comprising:

- an east network interface unit arranged, in use, to demultiplex an incoming WDM optical signal and to convert the incoming WDM optical signal into a plurality of electrical channel signals, and to convert and multiplex a plurality of electrical channel signals into an outgoing WDM optical signal,

25 - a west network interface unit arranged, in use, to demultiplex an incoming WDM optical signal and to convert the incoming WDM optical signal into a plurality of electrical channel signals, and to convert and multiplex a plurality of electrical channel signals into an outgoing WDM optical signal, and

- a regeneration unit disposed between the east and west interface units for regenerating the electrical channel signals utilising at least 2R regeneration.

21. An optical network node as claimed in claim 20, wherein the regenerator node comprises two interconnected ones of the WDM modules,

an east WDM module comprising:

- the east interface unit,
- 5 - an east element of the regeneration unit, and
- a first electrical interface unit,

and a west WDM module comprising:

- a second electrical interface unit,
- a west element of the regeneration unit, and
- 10 - the west interface unit,

wherein the east and west WDM modules are interconnected via the first and second electrical interface units.

22. A network node as claimed in claim 21, wherein one or both of the east and west WDM modules further comprises a switching element for enabling loop-back functionality for
15 remote diagnostics or for switching between different WDM channels.

23. A network node as claimed in any one of claims 20 to 22, wherein the regeneration unit is arranged for 3R regeneration.

24. A regenerator node for a WDM network, comprising:

20 - an east network interface unit arranged, in use, to demultiplex an incoming WDM optical signal and convert the incoming WDM optical signal into a plurality of electrical channel signals, and to convert and multiplex a plurality of electrical channel signals into an outgoing WDM optical signal,

25 - a west interface unit arranged, in use, to demultiplex an incoming WDM optical signal and to convert the incoming WDM optical signal into a plurality of electrical channel signals, and to convert and multiplex a plurality of electrical channel signals into an outgoing WDM optical signal, and

- a regeneration unit disposed between the east and west interface units for regenerating the electrical channel signals utilising at least 2R regeneration.

25. A regenerator node as claimed in claim 24, comprising:

an east WDM module comprising:

- the east interface unit,
- an east element of the regeneration unit, and
- a first electrical interface unit,

and a west WDM module comprising:

- a second electrical interface unit,
- a west element of the regeneration unit, and
- the west interface unit,

10 wherein the east and west WDM modules are interconnected via the first and second electrical interface units.

26. A regenerator node as claimed in claim 25, wherein one or both of the east and west WDM modules further comprises a switching element for enabling loop-back functionality for remote diagnostics or for switching between different WDM channels.

15 27. A regenerator node as claimed in any one of claims 24 to 26, wherein the regeneration unit is arranged for 3R regeneration.